

Atomic Defects in Structurally Complex Materials

Wolfgang Sprengel

Institute of Materials Physics, Graz University of Technology, Austria

The lecture series will give an introduction to defects on an atomic level in specific, structurally complex materials such as nanocrystalline bulk metals, bulk metallic glasses and quasicrystals. The unique properties of these materials arising from characteristic defect properties will be discussed and own research results of defect studies in these materials obtained by the specific experimental techniques of positron annihilation, time-dependent dilatometry and tracer diffusion experiments will be given. The subjects of the lectures will be:

- 1) The role of vacancies in nanocrystalline bulk metals
- 2) Free volume and the glass transition in bulk metallic glasses
- 3) Quasicrystals: Atomic defects, diffusion and disordering

References:

- [1] F. Ye, W. Sprengel, R.K. Wunderlich, H.-J. Fecht, H.-E. Schaefer, Reversible Atomic Processes as Basic Mechanisms of the Glass Transition, *Proceedings of the National Academy of Sciences* **104**, 12962 (2007)
- [2] W. Sprengel, Diffusion in Nanocrystalline Materials, in: *Nanostructured Materials; Processing, Properties, and Applications*, ed. C. Koch, William Andrew Publishing, (Norfolk, 2006) p331- 364
- [3] K. Sato, F. Baier, W. Sprengel, R. Würschum, H.-E. Schaefer, Study of an Order-Disorder Phase Transition on an Atomic Scale: The Example of Decagonal AlNiCo Quasicrystals, *Physical Review Letters* **92**, 127403 (2004)
- [4] K. Sato, F. Baier, A.A. Rempel, W. Sprengel, and H.-E. Schaefer, Observation of High-Temperature Thermal Vacancies in Al₇₀Pd₂₁Mn₉ Quasicrystal, *Physical Review B* **68**, 214203/1-4 (2003)
- [5] W. Sprengel, F. Baier, K. Sato, X.Y. Zhang, K. Reimann, R. Würschum, R. Sterzel, W. Assmus, F. Frey, H.-E. Schaefer, Vacancies, Atomic Processes, and Structural Transformations in Quasicrystals, in: *Quasicrystals: Structure and Properties*, Wiley-VCH, Weinheim, 2003, p. 414-429
- [6] W. Sprengel, M.A. Müller, and H.-E. Schaefer, Diffusion and Defect Structures, in: *Intermetallic Compounds, Vol. 3, Principles and Practice*, (eds.) J.H. Westbrook and R.L. Fleischer, J. Wiley and Sons, Chichester, UK, (2002), 275-293.